Identification of Epileptiform Complexes in Electroencephalogram using Adapted Continuous Wavelet Transform

Anton Popov, Mykhailo Zhukov, Alexey Kanaykin, Oleg Bodilovsky

Abstract - **In this paper the new method for time localization of epileptiform complexes in the human electroencephalogram is presented. The use of patient-adapted mother wavelet function allowed to reach the 93 % of true positive identification rate and 32 % of false positive identification rate.**

Keywords - **adaptive mother wavelet, continuous wavelet transform, EEG processing, eigenvector method, electroencephalography, epileptiform complex, epilepsy.**

I. INTRODUCTION

One of the fields of application of the wavelet transform-based signal processing is the analysis of the electroencephalograms (EEG). It is widely used in clinical practice for diagnosis of brain diseases.

In the case of EEG employing in epileptology it can be used for localization in the signal the waveforms of special form (so-called epileptiform complexes). These patterns are often the markers of presence of epileptic focus in the brain.

The proposed work considers the issue of employing the continuous wavelet transform (CWT) of the EEG for identification of the epileptiform patterns.

II. USING THE ADAPTED MOTHER WAVELET

The use of existing techniques of adaptive creation of mother wavelet functions requires large amount of additional information about signal under consideration and about the waveforms to be found.

The proposed technique allows CWT-based localization of epileptiform waveforms, when minor information about its spectral characteristics is available, which is the case in brain signals processing. In the first step, the matrix of the class of epileptiform complexes should be created. Then the matrix of averaged correlation is computed. The main eigenvector of this matrix is used to create the adapted mother wavelet following [1]. Then the technique of creating the basis set of scaled and dilated wavelet function for arbitrary scale coefficients was employed and the CWT of discrete EEG signal was performed with thresholding algorithm [2-3].

Clinical studies were carried out in the Department of Functional Diagnostics of Institute of Neurosurgery of Ukraine and in the Laboratory of Diagnostic Devices of the Department of Physical and Biomedical Electronics of National Technical University of Ukraine. All calculations were performed using specialized software in MatLab (MathWorks, 2002) using Biosig [4]. Presentation of achieved results is given on Fig. 1.

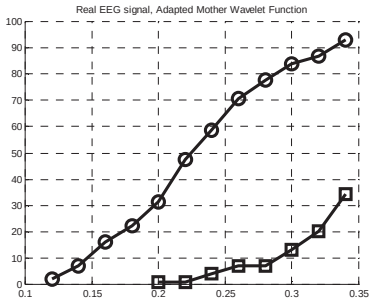

Fig.1 The rate of true positives (○) and false positives (□) versus the threshold for CWT with adapted mother wavelet function

III. CONCLUSION

Using the adapted mother wavelet in time localization of epileptiform complexes in electroencephalograms with continuous wavelet transform has some considerable advantages over using standard mother functions. This is confirmed by the results of clinical studies when processing the decomposition using adapted wavelet gave optimal combination of sufficient rate of true positive and acceptable rate of false positive localizations.

REFERENCES

[1] A. O. Popov, “Constructing mother wavelet functions by eigenvectors technique” (in Ukrainian), *Electronics and communications*, pp. 54-58, Feb. 2006.

[2] A. Popov, V. Zhukov, “Computation of continuous wavelet transform of discrete signals with adapted mother functions”, *Proceedings of SPIE*, Vol. 7502, 75021E-1 - 75021E-6.

[3] A. O. Popov, M. A. Zhukov, “Continuous Wavelet Transform of Discrete Signals without Integration” (in Ukrainian), *Electronics and communications*, № 4-5, pp. 151-155, Apr. 2009.

[4] Schloegl, A., ‘BIOSIG – an open source software library for biomedical signal processing’, viewed 16 July 2009, <*http://biosig.sourceforge.net/*>.

Anton Popov – National Technical University of Ukraine “Kyiv Politechnic Institute”, Peremogy ave., 37, Kyiv, 03056, UKARINE, E-mail: anton.popov@ieee.org

Mykhailo Zhukov – National Technical University of Ukraine “Kyiv Politechnic Institute”, Peremogy ave., 37, Kyiv, 03056, UKARINE,
E-mail: 3v1l91l@gmail.com

Alexey Kanaykin – Institute of Neurosurgery of Ukraine, Platona Maiborody Str., 32, 04050, UKRAINE
E-mail: kan-neuro@yandex.ru

Oleg Bodilovsky – National Technical University of Ukraine “Kyiv Politechnic Institute”, Peremogy ave., 37, Kyiv, 03056, UKARINE, E-mail: bodilowsky@gmail.com